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CORRESPONDENCE.

To the Editor of the American Naturalist:

SIR:—A little over a year ago Dr. William Patten¹ claimed to have discovered evidence of “numerous pairs of jointed oarlike appendages” in Tremataspis and related forms, in none of which had similar indications been previously detected. Nor, for that matter, had anyone previously had the temerity to attribute more than two pairs of limbs to any vertebrate creature, living or fossil. Beyond Dr. Patten’s assertion that Cephalaspis is provided with “a fringe of jointed and movable appendages (25–30 pairs) along the ventral margin of the trunk,” we have had from him no further enlightenment as to the ambulatory equipment of this Ostracophore, but there has recently been heard from Dr. Gaskell² an absolute denial of the existence of segmental appendages in that genus.

Now, since it appears that segmented appendages are wanting not only in Cephalaspis, but universally amongst the Heterostraci and Osteostraci so far as known, the presumption is certainly very strong that they do not occur in Tremataspis, whose close relationship with Cephalaspis none will question. Professor Patten, however, in returning to the matter *de novo*,³ combats against this presumption, and affirms his belief in the existence of not only one, but possibly *several* pairs of jointed appendages in Tremataspis. Naturally he must have strong reasons for inclining him to so heterodox a notion, and what are they, palæontologists are curious to know? Has he discovered specimens showing one or more pairs of these chimærical organs

¹ On the Structure and Classification of the Tremataspidae. *Amer. Nat.*, vol. 36. 1902, pp. 379–393.

² On the Origin of Vertebrates, *Journ. Anat. and Phys.*, vol. 37. 1903, p. 198, text fig. 5.

³ On the Appendages of Tremataspis. *Amer. Nat.*, vol. 37. 1903, pp. 223–242.

in situ? Or has he found detached appendages positively determinable as belonging to Tremataspis, to the exclusion of all other accompanying fossil remains? Professor Patten answers the first of these interrogatories in the negative, the second affirmatively. He has obtained in all four detached plates of small size and mediocre preservation, which he regards as portions of as many "paired cephalic appendages"; these he figures of ten times the natural size and describes in praiseworthy detail. But by what process of reasoning he is able to identify them as belonging indubitably to the genus Tremataspis he does not take the trouble to state, leaving the reader to take it for granted that his determination is correct.

Not all readers, however, will be prepared to accept a determination so utterly at variance with analogy. On the contrary, rational students will maintain that inasmuch as certain fish fragments are identifiable as parts of jointed oarlike appendages, that fact is *prima facie* evidence of their pertaining not to Tremataspis, but to an entirely different order of Ostracophores — the same to which Pterichthys, Bothriolepis and Asterolepis belong. This indeed was the view taken by Pander as early as 1856, who, so far from associating certain fragmentary appendages from the Baltic Silurian with Tremataspis, referred them to the Pterichthyid order, whose presence in those beds is not otherwise indicated. This procedure is entirely justified by the fact that structures of this nature are known to be present in the group typified by Pterichthys, but not in that to which Tremataspis and Cephalaspis belong. The danger of a reliance on merely superficial characters for the determination or theoretical association of detached fragments is well illustrated by Cope's confusion of an appendage of Bothriolepis with Holonema remains,¹ certainly no trifling error, and other instances are but all too common. To cite an analogous case borrowed from invertebrate palæontology, it is the same as if Professor Patten had found parts of a Eurypterus- or Pterygotus-like swimming appendage, and was misled by superficial resemblances into supposing it to have belonged to some genus of Trilobites

¹ On the Characters of some Palæozoic Fishes. *Proc. U. S. Nat. Mus.*, vol. 14. 1891, p. 456, pl. XXX. fig. 7.

occurring in the identical formation, and exhibiting similar texture or surface markings. We wonder how many would be converted to this belief until a Trilobite had first been discovered with the actual members preserved *in situ*?

In precisely the same way we must reject Professor Patten's theoretical association of parts as erroneous, and deny that forms like Tremataspis, Cyathaspis, Cephalaspis, Tolypelepis, etc., possessed paired segmented appendages until at least one single individual shall have come to light having the postulated organs

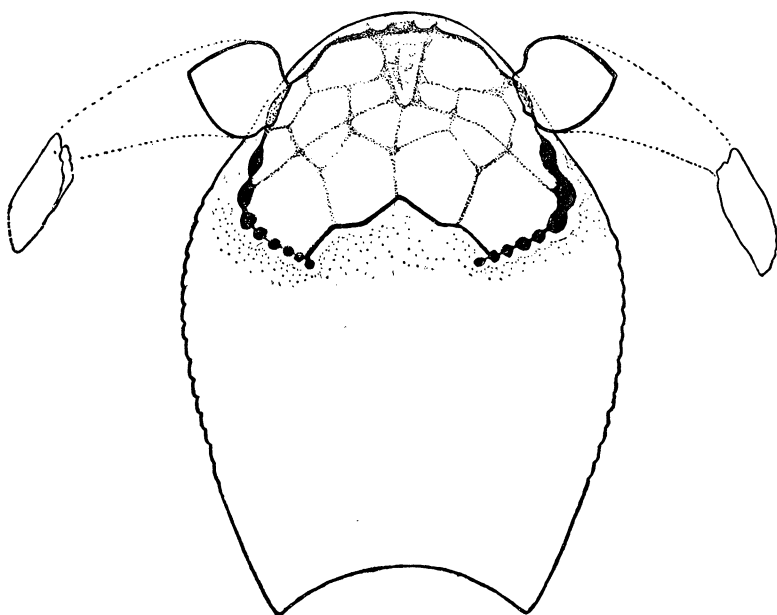


FIG. 1. Ventral aspect of the head-shield of Tremataspis (from Patten).

preserved *in situ*. We can also afford to await the discovery of a six- or eight-limbed vertebrate before abandoning a rather deep-seated prejudice in favor of a maximum number of two pairs of limbs.

Professor Patten calls attention to the marginal openings on the visceral side of the head-shield in Tremataspis, arguing that their ventral position furnishes strong reason for believing that they served for the attachment of appendages. But this argument, such as it is, is negatived by the fact that a row of

precisely similar openings occurs in *Birkenia* on either side of the body at its junction with the head, — that is to say, in a position where they would *not* be serviceable for the attachment of such organs. These openings are commonly regarded as branchial in function, in which case it is easy to conceive of them as having been diaposd in the two genera relatively as in the

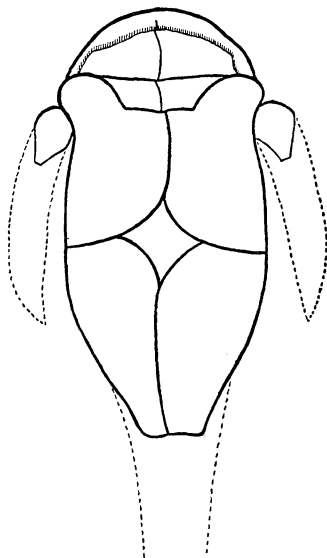


FIG. 2. Ventral aspect of the body-armor of *Pterichthys*.

skate and shark.¹ It is the veriest flight of fancy to suppose that the series of six lateral openings in *Birkenia*, and nine ventral ones in *Tremataspis*, imply the existence of as many pairs of segmental appendages in the respective forms. And were we to temper our imagination so far as to conceive that only two pairs of incisions served for this purpose, or indeed even one pair, what function should we assign for the rest, since they are all alike? Given an integral series, why complicate matters by postulating a multiple function? Either let us regard them provisionally as gill-openings, or else declare that their

nature is entirely problematical; Patten's guess we are not prepared to take seriously, even as a guess.

One point further must not escape attention. Our denial of the existence of appendages in *Tremataspis* is supported not only by analogy and negative evidence, but by the general configuration of the head-shield itself. The latter agrees with that of *Cephalaspis*, *Auchenaspis*, *Drepanaspis* and the like, in its convex or regularly elliptical outline, especially as seen from the ventral aspect, where according to Patten the appendages had their attachment (Fig. 1). But if we examine the visceral surface

¹ Traquair, R. H. Report on Fossil Fishes. *Trans. Roy. Soc. Edinburgh*, vol. 39, 1899, p. 859.

of Pterichthys, Bothriolepis or Asterolepis, we note at once that the contour of the body-wall is inflected, or even indented, on either side at the point where the pectoral limbs peculiar to these forms were attached (Fig. 2). This latter condition being governed by mechanical principles, as anyone can perceive, it is common only amongst those forms which possess swimming appendages. And its absence in Tremataspis and generally throughout the order to which it belongs fortifies us in our conclusion that in this group paired segmental appendages were wanting.

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